

STEM-BASED TEACHING MATERIAL NEEDS ANALYSIS TO IMPROVE STUDENT CREATIVITY

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Abstract

Innovation is the most important key in the 4.0 industrial era which requires education units to form students who have 21st century competencies and able to think critically, creatively, collaboratively, and communicatively. The STEM approach is one of the learning innovations that developed in the revolution 4.0 industrial era. STEM stands for Science, Technology, Engineering, and Mathematics. Learning with the STEM approach is identified as learning that combines four disciplines, namely Science, Technology, Engineering and Mathematics with a focus on the learning process that explores two or more fields that involve students actively in the context of problem solving in the real world. The Integrated application of STEM requires teachers and students to think creatively. The purpose of this study is to describe the need for STEM-based mathematics teaching materials that can increase students' creativity. This type of research is descriptive qualitative. The research subjects were students of 8th grade of SMP Negeri 3 Tempel (State Junior High School). Data collection techniques used interviews, observations, and tests. Data analysis used the Miles and Huberman model which consisted of data reduction, displaying data, and drawing Conclusion or verification. This research has several results. First, students' creative abilities are still relatively low. Second, the learning model and teaching materials used are less stimulating for students to improve their creativity abilities. Third, STEM-based learning can help students to improve students' creativity. From the results, this study concludes that STEM-based mathematics teaching materials that could stimulate students' creativity abilities need to be developed.

Keywords: Teaching materials students creative ability STEM

1. Introduction

Education is the foundation that can help develop students' abilities and prepare students for problem-solving, communication, and decision-making skills. 21st century education must be oriented towards mathematics and natural sciences accompanied by social and human sciences. Mathematics has the potential to improve the ability to think, argue, contribute to solving everyday problems and this potential can be realized if mathematics learning emphasizes the aspect of increasing higher order thinking skills which requires students to manipulate information and ideas in a certain way that gives them understanding, and new implications (Noer, 2009).

Education builds scientific attitudes that are critical, logical, analytical, creative and able to adapt. Based on the results of the 2018 Program for International Student Assessment (PISA) in the reading ability category, Indonesia was ranked 74th out of 79 countries, while for the assessment of mathematics and science abilities, Indonesia was ranked 73rd and 71st out of 79 countries. PISA participants. From these results, it can be concluded that the level of education in Indonesia is still very low compared to other countries. Basically, the assessment carried out by PISA emphasizes the skills needed in the 21st century, which according to PISA records as many as 21 countries do not have a curriculum that focuses on future planning required by global industry, especially in learning mathematics, while what is needed by the 21st century industry is the way critical thinking, creative, research-based, initiative, informative, systematic thinking, communicative and reflection (OECD, 2018). Greenstein (2012) explains that 21st century skills that must be mastered by students include: Thinking, Acting, and Living in the World. Thinking includes critical thinking, and solving problems. Acting includes communication, collaboration, technology literacy, flexibility and adaptability. Living in the world includes responsibility and leadership. Therefore, innovation is the most important key in the industrial era 4.0 which requires schools to form students who have 21st century competencies who are able to think critically,

creatively, collaboratively, and communicatively. creative and innovative by utilizing technology that is in line with the Industrial Revolution Era 4.0. These learning activities can facilitate students in constructing their own knowledge and applying it so as to train students' skills and expand the knowledge gained by students through learning activities.

The STEM approach is one of the learning innovations that developed in the Industrial Revolution 4.0 Era. STEM stands for Science, Technology, Engineering and Mathematics. Learning with the STEM approach is identified as learning that combines four disciplines, namely Science, Technology, Engineering and Mathematics by focusing on the learning process that explores two or more fields that involve students actively in the context of problem solving in the real world (Sanders, 2009); Roberts, 2012); Bybee, 2013. The integrated application of STEM indirectly requires teachers and students to think creatively. Teachers are required to be creative in developing teaching materials. Teaching materials used by teachers greatly affect student learning outcomes. In science learning, students are guided by teachers to actively find their own understanding related to learning materials. Problem solving activities characterize learning that develops creative thinking skills. Therefore, we need a teaching material to support the learning process, one of which is the Student Worksheet (LKPD). LKPD is a teaching material in the form of sheets containing instructions for use, steps to do assignments or work steps both theoretical and practical (Aldila, Abdurrahman, and Sesunan 2017). The use of LKPD can help students to learn independently and make it easier for students to understand the material. Students are expected to be able to find and develop mathematical concepts with the help of mathematics Student Worksheets (LKPD) so that they can form effective interactions between teachers and students, and can improve student activities in improving learning achievement because LKPD is one of the learning tools that is sufficient important (Relia 2012).

Based on the results of interviews with Mathematics teachers conducted by researchers on February 9, 2022 at SMP Negeri 3 Tempel, the teaching materials used are still using Package Books and LKS only, and there has been no development of learning using LKPD. So, it is still necessary to develop LKPD because based on the results of interviews with teachers, students still have difficulties in learning mathematics when using textbooks because there is too much material described in the textbook so there is a need for learning media that can summarize the material in the textbook so that students can understand mathematics easily but still in accordance with the Basic Competencies to be achieved. Based on a preliminary study questionnaire conducted in class VIII D at SMPN 3 Tempel that 53.12% of students are sleepy and not enthusiastic when learning mathematics and 53.12% of students feel bored when explained by the teacher in front class therefore there is a need for pe developing interesting teaching materials so that students can feel more interested in learning mathematics.

Therefore, so that students are more interested in learning mathematics, it is necessary to develop STEM-based LKPD teaching materials because based on the results of Aminingsih and Nur Izzati's research at SMPN 7 Tanjungpinang that the development of STEM-based learning modules on set material obtained the "very feasible" category with a percentage of 92% . Student responses to the STEM-based learning module on the set material obtained the "interesting" category with a percentage of 76.77%, then the teacher's response was obtained in the "very interesting" category with a percentage of 84.99%. So, the STEM-based learning module is very feasible to use. According to research conducted by Eva Susanti and Haris Kurmiawan at SMP Negeri 27 Palembang, it can be concluded that learning the number pattern material for the PjBL learning model with the STEM approach provides students with enthusiastic activities in learning, students who are creative in being creative, students who are active in discussions, and students who are active in discussions. able to study in groups to complete an assigned project. The difference between this study and previous research is that this study will only describe the need for STEM-Based Teaching Materials to Increase Creativity of VIII Grade Students of SMP Negeri 3 Tempel in mathematics.

2. Method

This type of research is descriptive qualitative research. With this descriptive technique, the researcher will describe or describe the data that has been collected about an object so that a conclusion can be obtained. The subjects in this study were class VIII D students of SMP Negeri 3 Tempel, Sleman, Yogyakarta for the academic year 2021-2022, totaling 32 students. The data was conducted in March 2022. The focus of this research is to describe the need for STEM-based mathematics teaching materials that can increase students' creativity. Data collection techniques used interviews, preliminary study questionnaires and test scores. Interviews were

conducted to the VIII grade mathematics teacher in order to obtain information about student characteristics, learning models and learning media needs. While the preliminary study questionnaire Then, the test scores were used to determine the students' creativity ability in solving math problems. The creative thinking ability test used has been validated by the validator and declared valid to be used as a research instrument. In accordance with this type of research, the researchers used an interactive model from Miles and Huberman to analyze the research data.

3. Results and Discussion

The results in this study are the results of interviews with mathematics teachers at SMP Negeri 3 Tempel, student response questionnaires and initial test data in the form of students' creative abilities. By observing mathematics teachers and students at SMP Negeri 3 Tempel. During the pandemic period, SMP Negeri 3 Tempel enforced a system of 50% studying at home and 50% studying at school. Based on the results of the questionnaire distributed, there were 78.12% of students experiencing difficulties when studying online at home so that teaching materials were needed that could answer the needs of students to make it easier for students to understand mathematics even though learning online so that teaching materials were needed in the form of E-LKPD. that the teaching materials used are still using Package Books and LKS only, and it is still rare to use learning in the form of LKPD. So, it is still necessary to develop teaching materials in the form of LKPD because based on the results of interviews with teachers, students still experience difficulties in learning mathematics when using textbooks because too much material is described in the textbook so there is a need for learning media that can summarize the material in the textbook so that students can understand mathematics easily but still in accordance with the Basic Competencies to be achieved.

The researcher in this study took the data in the form of a test of students' creativity abilities on geometry material to class VIII D students at SMP Negeri 3 Tempel by using 4 essay questions to determine students' creativity in answering. Previously, it was validated by a Mathematics Teacher at SMP Negeri 3 Tempel. In collecting data in the form of a creativity test, students used four aspects of creativity according to Torrance, namely (1) fluency (fluency, reducing many ideas); (2) originality (originality, compiling something new); (3) flexibility (flexibility, changing perspective easily); and (4) elaboration (elaboration, developing other ideas from an idea) in (Gilferd and Torrance, 2012)

In this study, the researcher used an analysis of students' creative thinking skills using categories developed in research by Suharsimi Arikunto (2006) and also used in research by Eka Desti Kusumawati et al (2018).

Table 1. Category of Student's Creative Thinking Level

No.	Students' Creative Thinking Ability Interval	Category
1.	$81,25 \leq N < 100$	Very Creative
2	$62,5 \leq N < 81,25$	Creative
3.	$43,75 \leq N < 62,5$	Pretty Creative
4.	$25 \leq N < 43,75$	Less Creative

The level of creative thinking ability is stated at a high level if students are in the very creative and creative category. While students at low levels are in the category of quite creative and less creative. The following are the results of the analysis of the average ability of class VIII D students at SMP Negeri 3 Tempel with a total of 32 students taking the test.

Table 2. Analysis of Student Creativity Ability

No.	Indicator of Creative Thinking Ability	Question number	Average Percentage of Student Answers (%)	Category
1.	Fluency	1	79,69	Very Creative

2.	Originality	2	72,65	Creative
3.	Flexibility	3	18,75	Pretty Creative
4.	Elaboration	4	27,34	Less Creative
	Creative Thinking Ability		49,6	Pretty Creative

Based on the description in Table 1 above, it shows that the creativity ability of class VIII D students at SMP Negeri 3 Tempel is in the category of Creative Enough with the average achievement of student answers in the fluency aspect of 79.69% in the creative category. creative thinking in the original aspect (originality) obtained an achievement of 72.65% in the creative category while the average results of student answers in the flexibility and elaboration aspects were still quite low when compared to the achievements in other aspects where in the aspects of Flexibility was only achieved by 18.75% students in the less creative category. While in the elaboration aspect it was 27.34%. From the average results, all students of class VIII D at SMP Negeri 3 Tempel are still in the category of a low level of creativity. The analysis of students' creativity abilities is based on the following sub-indicators.

Aspect of Fluency

According to Torrance (cited by Carter, 2000), fluency is the ability to generate an idea and the ability to produce a number of ideas, the answers to which vary. In the aspect of smoothness, the average results achieved by students in this aspect are 79.69%. In this study, on average, students were able to explain problems and sparked many ideas, answers, problem solving or questions. There are students in answering the question in number 1 with indicators of the fluency aspect being able to spark some ideas or answers, but the answers given by students are incomplete or still wrong, but most students can generate many ideas and answers.

Aspect of originality

According to Torrance (quoted by Carter, 2000) Aspect of originality, namely the ability to produce an idea that is original and unique. In this aspect the average test results of students' creativity abilities are 72.65%. Students are able to think about problems or things. -Things that other people don't think of, questioning old ways and trying to think of new ways to find new solutions.

Aspect of flexibility

In Table 2 it can be seen that the indicator aspect of creative thinking in the aspect of flexibility has a low achievement. This is because some students have not been able to produce ideas, answers, or questions that vary and are not accompanied by reasons, but there are also some students who can see the problem from a different point of view, and look for many different alternatives, but they have difficulty in classifying it. problem from different angles and solve the given problem.

Aspect of Elaboration

According to Torrance (quoted by Carter, 2000), elaboration is the ability to develop ideas so that they become more interesting. In this aspect the average creative thinking ability test results of students are 27.34% with the category of less creative. low because most students are still confused in developing answers to math problems in the form of descriptions.

Based on the results of the analysis in Table 2 and the analysis of 4 aspects of creative thinking indicators, it can be concluded that students' creative abilities are still low. So that a form of learning is needed that can improve students' creative abilities, one way is by using STEM learning because according to (Rissanen, 2014) that based learning STEM is able to improve students' creative thinking skills in a relatively short time and is able to make it easier for students to understand a learning material. Furthermore, the results of interviews with mathematics teachers showed that the teaching materials used were worksheets and textbooks but students still had difficulties in learning mathematics when using books. the package because there is too much material that is described in the textbook so that there is a need for teaching materials in the form of LKPD which can summarize the material in the textbook so that students can understand mathematics easily but still in accordance with Basic Competencies.

4. Conclusion

Based on the description of the research results above, this study has several results. First, students' creative abilities are still relatively low. Second, the learning model and teaching materials used are still less stimulating for students to improve students' creative abilities. Third, STEM-based learning can help students to increase students' creativity. This study concludes that STEM-based mathematics teaching materials can stimulate students' creative abilities and need to be developed.

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